

CLAIMS

1. A substrate processing method for removing unnecessary interconnect material and barrier material on a substrate and flattening a surface of the substrate, wherein said interconnect material is embedded in interconnect recesses, said interconnect recesses being formed on a surface of an insulating material and having a film of said barrier material formed on the surface of an insulating material, said method comprising:
- 5 eliminating a level difference in the surface of the interconnect material to flatten the surface;
- 10 removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate becomes a thin film or remains partly on the barrier material;
- 15 removing the interconnect material in the form of the thin film or remaining partly on the barrier material, thereby exposing the barrier material or further processing the barrier material;
- 20 simultaneously removing the unnecessary interconnect material and the barrier material until the barrier material present in the non-interconnect region becomes a thin film or remains partly; and
- 25 removing the unnecessary interconnect material and the barrier material present in the non-interconnect region, thereby exposing the insulating material in the non-interconnect region or further processing the insulating material.
2. The substrate processing method according to claim 1 further comprising simultaneously removing the unnecessary interconnect material, the barrier material and the insulating material.
- 30

3. A substrate processing method for removing unnecessary interconnect material and barrier material on a substrate and flattening a surface of the substrate, wherein said interconnect material is embedded in interconnect recesses, said interconnect
5 recesses being formed on a surface of an insulating material and having a film of said barrier material formed on the surface of an insulating material, said method comprising:

a first step of eliminating a level difference in the surface of the interconnect material to flatten the surface;

10 a second step of removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate becomes a thin film or remains partly on the barrier material;

a third step of removing the interconnect material in the
15 form of the thin film or remaining partly on the barrier material, thereby exposing the barrier material or further processing the barrier material;

a fourth step of simultaneously removing the unnecessary interconnect material and the barrier material until the barrier
20 material present in the non-interconnect region becomes a thin film or remains partly; and

a fifth step of removing the unnecessary interconnect material and the barrier material present in the non-interconnect region, thereby exposing the insulating
25 material in the non-interconnect region or further processing the insulating material.

4. The substrate processing method according to claim 3 further comprising a sixth step of simultaneously removing the
30 unnecessary interconnect material, the barrier material and the insulating material.

5. The substrate processing method according to claim 1 or 3, wherein the step of eliminating a level difference in the
35 surface of the interconnect material to flatten the surface is carried out by cutting or grinding.

6. The substrate processing method according to claim 1 or 3, wherein the step of eliminating a level difference in the surface of the interconnect material is carried out by CMP.

5 7. The substrate processing method according to claim 1 or 3, wherein the step of eliminating a level difference in the surface of the interconnect material is carried out by electrolytic processing, composite electrolytic processing or
10 abrasive processing utilizing an electrostatic or magnetic force.

8. The substrate processing method according to claim 1 or 3, wherein the step of eliminating a level difference in the surface of the interconnect material is carried out by
15 electrolytic processing utilizing a catalyst.

9. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material until the interconnect material present in the non-interconnect region
20 of the substrate becomes a thin film or remains partly on the barrier material is carried out by CMP.

10. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material until the interconnect material present in the non-interconnect region
25 of the substrate becomes a thin film or remains partly on the barrier material is carried out by electrolytic processing or composite electrolytic processing.

30 11. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate becomes a thin film or remains partly
35 on the barrier material is carried out by electrolytic processing utilizing a catalyst.

12. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate becomes a thin film or remains partly on the barrier material is carried out by abrasive processing utilizing an electrostatic or magnetic force.

13. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate becomes a thin film or remains partly on the barrier material is carried out by dry etching or chemical etching.

14. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material present in the non-interconnect region or remaining partly on the barrier material is carried out by CMP.

15. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material present in the non-interconnect region or remaining partly on the barrier material is carried out by electrolytic processing or composite electrolytic processing.

16. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material present in the non-interconnect region or remaining partly on the barrier material is carried out by electrolytic processing utilizing a catalyst.

17. The substrate processing method according to claim 1 or 3, wherein the step of removing the interconnect material present in the non-interconnect region or remaining partly on the barrier material is carried out by dry etching or chemical etching.

18. The substrate processing method according to claim 1 or 3, wherein the step of simultaneously removing the unnecessary interconnect material and the barrier material until the barrier material present in the non-interconnect region becomes a thin film or remains partly is carried out by CMP.

19. The substrate processing method according to claim 1 or 3, wherein the step of simultaneously removing the unnecessary interconnect material and the barrier material until the barrier material present in the non-interconnect region becomes a thin film or remains partly is carried out by composite electrolytic processing or a common electrolytic processing.

20. The substrate processing method according to claim 1 or 3, wherein the step of simultaneously removing the unnecessary interconnect material and the barrier material until the barrier material present in the non-interconnect region becomes a thin film or remains partly is carried out by electrolytic processing utilizing a catalyst.

21. The substrate processing method according to claim 1 or 3, wherein the step of simultaneously removing the unnecessary interconnect material and the barrier material until the barrier material present in the non-interconnect region becomes a thin film or remains partly is carried out by dry etching or chemical etching.

22. The substrate processing method according to claim 1 or 3, wherein the step of simultaneously removing the unnecessary interconnect material and the barrier material until the barrier material present in the non-interconnect region becomes a thin film or remains partly is carried out by independent processings of the interconnect material and of the barrier material.

23. The substrate processing method according to claim 1 or 3, wherein the step of removing the unnecessary interconnect material and the barrier material present in the non-interconnect region is carried out by CMP.

5

24. The substrate processing method according to claim 1 or 3, wherein the step of removing the unnecessary interconnect material and the barrier material present in the non-interconnect region is carried out by electrolytic processing or composite electrolytic processing.

10

25. The substrate processing method according to claim 1 or 3, wherein the step of removing the unnecessary interconnect material and the barrier material present in the non-interconnect region is carried out by electrolytic processing utilizing a catalyst.

15

26. The substrate processing method according to claim 1 or 3, wherein the step of removing the unnecessary interconnect material and the barrier material present in the non-interconnect region is carried out by dry etching or chemical etching.

20

27. The substrate processing method according to claim 2 or 4, wherein the step of simultaneously removing the unnecessary interconnect material, the barrier material and the insulating material is carried out by CMP.

25

28. The substrate processing method according to claim 2 or 4, wherein the step of simultaneously removing the unnecessary interconnect material, the barrier material and the insulating material is carried out by dry etching or chemical etching.

30

29. A substrate processing method for removing unnecessary interconnect material and barrier material on a substrate and flattening a surface of the substrate, wherein said interconnect material is embedded in interconnect recesses, said interconnect
5 recesses being formed on a surface of an insulating material and having a film of said barrier material formed on the surface of an insulating material, said method comprising:

removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate
10 becomes a thin film or remains partly; and then

completely removing the interconnect material, present in the non-interconnect region, in the form of the thin film or remaining partly, thereby exposing an underlying material present under the interconnect material in the non-interconnect
15 region.

30. The substrate processing method according to claim 29, wherein the step of removing the interconnect material until the interconnect material present in the non-interconnect region of
20 the substrate becomes a thin film or remains partly comprises an additional step of eliminating a level difference in the surface of the interconnect material.

31. The substrate processing method according to claim 29,
25 wherein the step of removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate becomes a thin film or remains partly is terminated when the film thickness of the interconnect material present in the non-interconnect region has reached a value of not more than
30 300 nm.

32. The substrate processing method according to claim 29, wherein the film thickness of the interconnect material present in the non-interconnect region is detected with an eddy
35 current-type or optical film thickness measuring means.

33. The substrate processing method according to claim 29, wherein the processing rate of the interconnect material in the step of completely removing the interconnect material, present in the non-interconnect region, in the form of the thin film or remaining partly is lower than the processing rate of the interconnect material in the step of removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate becomes a thin film or remains partly.

10

34. The substrate processing method according to claim 29, wherein the step of completely removing the interconnect material, present in the non-interconnect region, in the form of the thin film or remaining partly is carried out by using a processing liquid or a chemical liquid.

15

35. The substrate processing method according to claim 29, wherein the step of completely removing the interconnect material, present in the non-interconnect region, in the form of the thin film or remaining partly is carried out while applying a first pressure to the substrate, and the step of removing the interconnect material until the interconnect material present in the non-interconnect region of the substrate becomes a thin film or remains partly is carried out while applying a second pressure, which is lower than the first pressure, to the substrate.

20

25

36. The substrate processing method according to claim 29 further comprising removing the underlying material present in the non-interconnect region until a material present under the underlying material becomes exposed.

30

37. The substrate processing method according to claim 36, wherein the step of removing the underlying material comprises a step of removing the underlying material until the underlying material becomes a thin film or remains partly, and a step of removing the underlying material in the non-interconnect region until the material present under the underlying material becomes exposed.

38. A substrate processing method for removing unnecessary interconnect material and barrier material on a substrate and flattening a surface of the substrate, wherein said interconnect material is embedded in interconnect recesses, said interconnect recesses being formed on a surface of an insulating material and having a film of said barrier material formed on the surface of an insulating material, said method comprising:

simultaneously removing the unnecessary interconnect material and barrier material until the barrier material present in the non-interconnect region of the substrate becomes a thin film or remains partly; and then removing the unnecessary interconnect material and the barrier material in the form of the thin film or remaining partly, thereby exposing an underlying material present under the barrier material in the non-interconnect region.

39. The substrate processing method according to claim 38, wherein the step of removing the unnecessary interconnect material and the barrier material in the form of the thin film or remaining partly is carried out while applying a first pressure to the substrate, and the step of simultaneously removing the unnecessary interconnect material and barrier material until the barrier material present in the non-interconnect region of the substrate becomes a thin film or remains partly is carried out while applying a second pressure, which is lower than the first pressure of the second step, to the substrate.

40. A substrate processing apparatus, comprising:
an electrolytic processing section, provided with an end
point detection device, for carrying out electrolytic processing
of a substrate held by a substrate holder;
5 a CMP section, provided with an end point detection device,
for carrying out chemical mechanical polishing of the substrate
held by a substrate holder; and
a substrate transfer device for transferring the
substrate;
10 wherein the substrate is processed both in the electrolytic
processing section and in the CMP section.

41. The substrate processing apparatus according to claim
40, wherein the electrolytic processing includes composite
15 electrolytic processing, electrolytic processing using an
electrolytic solution, electrolytic processing utilizing a
catalyst, and a common electrolytic processing.